

CLAIMS

1. A process for separating air by cryogenic distillation in an installation comprising a double or
5 triple air separation column (100, 200), the column of which operating at the higher pressure (100) operates at what is called the medium pressure, and an exchange line (9) in which:

a) all the air is raised to a high pressure,
10 optionally at least 5 bar above the medium pressure, and purified, optionally at this high pressure;

b) one portion of the stream of purified air is cooled in the exchange line and is then divided into two fractions;

15 c) each fraction is expanded in a turbine (17, 19);

d) the intake pressure of the two turbines is (the intake pressures of the two turbines are) at least 5 bar above the medium pressure;

20 e) the delivery pressure of at least one of the two turbines is substantially equal to the medium pressure;

f) at least one portion of the air expanded in at least one of the turbines is sent to the medium-
25 pressure column of a double or triple column;

g) a cold booster (23) mechanically coupled to one of the expansion turbines takes in air, which has undergone cooling in the exchange line, and delivers the air at a temperature above the intake temperature,
30 and the fluid thus compressed is reintroduced into the exchange line in which at least one portion of the fluid undergoes (pseudo)condensation;

h) at least one pressurized liquid coming from one of the columns undergoes (pseudo)vaporization in the
35 exchange line at a vaporization temperature, and characterized in that:

i) the turbine (17) not coupled to the cold booster is coupled to a booster (5) followed by a cooler; and, optionally,

5 ii) the intake temperature of the cold booster (23) is close to the (pseudo)vaporization temperature of the liquid.

2. The process as claimed in claim 1, in which the installation includes, in addition to the double or
10 triple column, a mixing column (300), and air coming from at least one of the turbines (17, 19) is sent to the mixing column, optionally after having passed through the medium-pressure column (100).

15 3. The process as claimed in claim 2, in which the air sent to at least one of the turbines (17, 19) upstream of the mixing column comes from the booster (5) other than the cold booster (23) and leaves this booster at a pressure above the high pressure.

20 4. The process as claimed in either of claims 2 and 3, in which air (13, 15) expanded in at least one of the turbines (17, 19) is sent to the bottom of the mixing column (300), in order to participate in mass
25 exchange therein.

5. The process as claimed in claim 1, in which air (123) at least at the high pressure is sent to a bottom reboiler (301) of the mixing column (300) where it at
30 least partially condenses before being sent to the double or triple column.

6. An installation for separating air by cryogenic distillation, comprising:

35 a) a double or triple air separation column (100, 200), the column (100) of which, operating at the higher pressure, operates at what is called the medium pressure;

b) an exchange line (9);

c) means for raising all the air to a high pressure, above the medium pressure, and means for purifying it, optionally at this high pressure;

5 d) means for sending one portion of the purified air stream into the exchange line in order to cool it and means for dividing this cooled air into two fractions;

10 e) two turbines (17, 19) and means for sending one air fraction to each turbine;

f) means for sending at least one portion of the air expanded in at least one of the turbines to the medium-pressure column of the double or triple column;

15 g) a cold booster (23), means for sending air, preferably withdrawn from an intermediate point on the main exchange line, to the cold booster and means for sending air boosted in the cold booster into the exchange line at an intermediate point upstream of the withdrawal point;

20 h) means (500) for pressurizing at least one liquid coming from one of the columns, means for sending the at least one pressurized liquid into the exchange line, and means for expelling a vaporized liquid from the exchange line; and

25 i) the cold booster is coupled to one of the turbines (19), characterized in that the turbine (17) not coupled to the cold booster is coupled to a booster (5) followed by a cooler.

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7. The installation as claimed in claim 6, which includes a mixing column and means for sending air to the mixing column from at least one of the turbines (17, 19).

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8. The installation as claimed in claim 7, which includes means for sending one portion of the air compressed in the booster (5) constituting the energy

dissipation means, or forming part of the latter, to at least one expansion turbine (17, 19) upstream of the mixing column.

- 5 9. The installation as claimed in either of claims 7 and 8, which includes means for sending air, coming from at least one of the turbines (17, 19), into the mixing column in order to participate in mass exchange therein.

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10. The installation as claimed in claim 6, which includes means for sending air (123) at least at the high pressure into a bottom reboiler (301) of the mixing column (300) and means for sending air at least
15 partially condensed in this bottom reboiler to the double or triple column.

AMENDED CLAIMS

[received by the International Office on 4 July 2005 (04.07.2005);
original claims 1-10 replaced with amended claims 1-8 (3 pages)]

- 5 1. A process for separating air by cryogenic distillation in an installation comprising a double or triple air separation column (100, 200), the column of which operating at the higher pressure (100) operates at what is called the medium pressure, and an exchange
10 line (9) in which:
- a) all the air is raised to a high pressure, optionally at least 5 bar above the medium pressure, and purified, optionally at this high pressure;
 - b) one portion of the stream of purified air is
15 cooled in the exchange line and is then divided into two fractions;
 - c) each fraction is expanded in a turbine (17, 19);
 - d) the intake pressure of the two turbines is (the
20 intake pressures of the two turbines are) at least 5 bar above the medium pressure;
 - e) the delivery pressure of at least one of the two turbines is substantially equal to the medium pressure;
 - 25 f) at least one portion of the air expanded in at least one of the turbines is sent to the medium-pressure column of a double or triple column;
 - g) a cold booster (23) mechanically coupled to one of the expansion turbines takes in air, which has
30 undergone cooling in the exchange line, and delivers the air at a temperature above the intake temperature, and the fluid thus compressed is reintroduced into the exchange line in which at least one portion of the fluid undergoes (pseudo)condensation;
 - 35 h) at least one pressurized liquid coming from one of the columns undergoes (pseudo)vaporization in the exchange line at a vaporization temperature, and

i) the turbine (17) not coupled to the cold booster is coupled to a booster (5) followed by a cooler; and, optionally,

5 j) the intake temperature of the cold booster (23) is close to the (pseudo)vaporization temperature of the liquid,

characterized in that the installation includes, in addition to the double or triple column, a mixing column (300), and air coming from at least one of the
10 turbines (17, 19) is sent to the mixing column, optionally after having passed through the medium-pressure column (100).

2. The process as claimed in claim 1, in which the
15 air sent to at least one of the turbines (17, 19) upstream of the mixing column comes from the booster (5) other than the cold booster (23) and leaves this booster at a pressure above the high pressure.

20 3. The process as claimed in either of claims 1 and 2, in which air (13, 15) expanded in at least one of the turbines (17, 19) is sent to the bottom of the mixing column (300), in order to participate in mass exchange therein.

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4. The process as claimed in claim 1, in which air (123) at least at the high pressure is sent to a bottom reboiler (301) of the mixing column (300) where it at least partially condenses before being sent to the
30 double or triple column.

5. An installation for separating air by cryogenic distillation, comprising:

a) a double or triple air separation column (100, 200), the column (100) of which, operating at the
35 higher pressure, operates at what is called the medium pressure;

b) an exchange line (9);

c) means for raising all the air to a high pressure, above the medium pressure, and means for purifying it, optionally at this high pressure;

5 d) means for sending one portion of the purified air stream into the exchange line in order to cool it and means for dividing this cooled air into two fractions;

e) two turbines (17, 19) and means for sending one air fraction to each turbine;

10 f) means for sending at least one portion of the air expanded in at least one of the turbines to the medium-pressure column of the double or triple column;

15 g) a cold booster (23), means for sending air, preferably withdrawn from an intermediate point on the main exchange line, to the cold booster and means for sending air boosted in the cold booster into the exchange line at an intermediate point upstream of the withdrawal point;

20 h) means (500) for pressurizing at least one liquid coming from one of the columns, means for sending the at least one pressurized liquid into the exchange line, and means for expelling a vaporized liquid from the exchange line;

25 i) the cold booster is coupled to one of the turbines (19); and

j) the turbine (17) not coupled to the cold booster is coupled to a booster (5) followed by a cooler,
characterized in that it includes a mixing column and
30 means for sending air to the mixing column from at least one of the turbines (17, 19).

6. The installation as claimed in claim 5, which includes means for sending one portion of the air
35 compressed in the booster (5) constituting the energy dissipation means, or forming part of the latter, to at least one expansion turbine (17, 19) upstream of the mixing column.

7. The installation as claimed in either of claims 5 and 6, which includes means for sending air, coming from at least one of the turbines (17, 19), into the
5 mixing column in order to participate in mass exchange therein.

8. The installation as claimed in claim 5, which includes means for sending air (123) at least at the
10 high pressure into a bottom reboiler (301) of the mixing column (300) and means for sending air at least partially condensed in this bottom reboiler to the double or triple column.